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Can kinesiophobia predict the duration of neck symptoms in acute whiplash?

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Can Kinesiophobia Predict the Duration of Neck Symptoms in Acute Whiplash?

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Objectives: In low back pain, clinical studies suggest that kinesiophobia (fear of movement/(re)injury) is important in the etiology of chronic symptoms. In this prospective cohort study, the predictive role of kinesiophobia in the development of late whiplash syndrome was examined.

Methods: Victims of car collisions with neck symptoms who initiated compensation claim procedures with a Dutch insurance company were sent a questionnaire containing symptom-related questions and the Tampa Scale of Kinesiophobia (TSK-DV). Follow-up questionnaires were administered 6 and 12 months after the collision. Survival analysis was used to study the relationship between the duration of neck symptoms and explanatory variables.

Results: Of the 889 questionnaires sent, 590 (66%) were returned and 367 used for analysis. The estimated percentage of subjects with neck symptoms persisting 1 year after the collision was 47% (SE 2.7%). In a regression model without symptom-related variables, kinesiophobia was found to be related to a longer duration of neck symptoms ($P = 0.001$). However, when symptom-related information was entered into the model, the effect of kinesiophobia did not reach statistical significance ($P = 0.089$).

Conclusions: Although a higher score on the TSK-DV was found to be associated with a longer duration of neck symptoms, information on early kinesiophobia was not found to improve the ability to predict the duration of neck symptoms after motor vehicle collisions.

Key Words: post-whiplash syndrome, kinesiophobia, litigation

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Few medical subjects give rise to as much discussion and controversy as whiplash.[1–5] Although the term "whiplash" is widely used, it is not so much a diagnosis as a description of an injury process. The chronic syndrome, with long-lasting symptoms and without evidence of structural or somatic trauma, is often referred to as late or post-whiplash syndrome.

In the past decades, many studies on chronic neck symptoms after motor vehicle collisions have been published in search of discriminating etiologic factors.[6,7] Studies on somatic theories and mechanical aspects of the trauma are still being published, but recently more articles have focused on psychological, cultural, and social factors as an explanation for the various characteristics of this syndrome.[1,5,8–13]

Although still subject to debate, a general consensus is building that post-whiplash syndrome should be regarded as a functional somatic syndrome with etiologic factors known to be involved in similar syndromes.[1,14,15] A recent systematic review of prognostic factors stated that high initial pain intensity, restricted cervical range of motion, high number of symptoms, previous psychological problems, and nervousness are considered risk factors for delayed recovery, although the available evidence is not very strong.[16] Therefore, additional research on possible etiologic and predictive variables, including behavioral and cognitive aspects, is needed.

One such potential factor is kinesiophobia. Kinesiophobia is a specific pain-related fear in which a patient has an excessive, irrational, and debilitating fear of physical movement and activity resulting from a feeling of vulnerability to painful injury or reinjury.[17] Fear of movement leads to inactivity and is a good predictor for disability in the case of chronic low back pain.[18] Pain-related fear plays a central role in the fear-avoidance model. This model offers a framework for conceptualizing the process of developing chronic low back pain.[19]

In low back pain, clinical studies suggest that an excessively negative orientation toward pain "catastrophizing" and fear of movement/(re)injury are important in the etiology of chronic symptoms.[20] In the fear-avoidance model, catastrophizing leads to pain-related fear, leading to avoidance behavior including avoidance of movement and physical activity.[19] In low back pain, fear-avoidance beliefs are identified as risk factors for chronic low back symptoms, suggesting that these factors are causal.[20]

Furthermore, patients with chronic low back pain who retrospectively reported a sudden traumatic pain onset exhibited higher kinesiophobia than patients who reported that the pain symptoms started gradually.[18]

Because in the case of whiplash, it is known that early active treatment is preferable, a passive attitude induced by fear of movement can also play a role in the development of post-whiplash syndrome.[21–23] For treatment, it is of course of great importance to know whether fear is the main factor leading to inactivity. Therefore, because of the apparent role of kinesiophobia in the transition from acute to chronic low back pain, it is conceivable that it could play a role in recovery from acute neck pain as well.[20] Recent research in this context appears to support this idea.[24,25] Nederhand et al recently concluded that a test for fear of movement can be used to help predict the outcome of traumatic neck pain.[25] In this 1-year prospective study we investigated the predictive value of early kinesiophobia on the duration of neck symptoms after motor vehicle collisions.

METHODS

Participants

Over a 10-month period, we invited all car collision victims with neck symptoms who had initiated compensation claim procedures with a Dutch insurance company to participate in the study. We excluded claimants younger than 18 or older than 65 years of age, and victims with structural injuries, loss of consciousness, or a history of chronic pain.

In The Netherlands, the settlement of personal injury claims is based on liability insurance, where accident victims seek compensation from the insurer of the driver at fault. The letter of invitation made it clear that the study was independent of the compensation procedure.

Questionnaires

We sent the claimants a questionnaire (Q1) concerning the collision and their symptoms at that time (Table 1). We also asked the claimants to complete the Tampa Scale of Kinesiophobia (TSK).[17] The TSK is a 17-item, 4-point questionnaire that measures the fear of (re)injury due to movement. The Dutch version of the TSK (TSK-DV) has good reliability and validity.[18,25–27]

Six (Q2) and 12 (Q3) months after the collision, we monitored the course of the symptoms by means of two identical questionnaires that contained a subset of questions of Q1. When the neck symptoms had ceased, the victims were asked how long they had lasted. From these data the duration of neck symptoms was calculated.

Statistical Analysis

We used Cox model regression to study the relationship between duration of neck symptoms and explanatory variables.[28] We analyzed both the total duration of symptoms starting from the collision and the duration of symptoms after filling out Q1. The former analysis involved all eligible subjects and explanatory variables known at the time of the collision. The latter analysis included only subjects with symptoms at the time of filling out Q1. In this analysis we examined the role of the TSK-DV score and of the symptom-related information, while correcting for possible confounding variables. The delay in filling out Q1 (the time between the collision and Q1) and the period in which the accident took place were also included in the analysis.

In Cox regression analysis, the effect of an explanatory variable on the duration of symptoms is expressed as a hazard ratio (HR). An HR less than 1 corresponds to a situation where a higher value for the explanatory variable results in a longer duration; an HR above 1 corresponds to a shorter duration. HR is 1 when there is no relation.

To investigate the effect of nonresponse, we compared the time-to-claim closure of respondents and partial respondents. Time-to-claim closure—the time between the collision and the moment the claim compensation procedure ends—is used in automobile insurance studies.[29] We used 5% as the nominal level of statistical significance.

The TSK-DV score and the initial symptoms (Q1) were recorded at the same time. To determine whether the TSK-DV score can be predicted from these symptoms, we carried out multiple linear regressions with sex, age, and symptom variables as the independent variables. Computations were carried out using the statistical package SPSS 11.

TABLE 1. Overview of Variables Analyzed in Relation to the Duration of Neck Symptoms

Variable	Values
Age	Years
Gender	Male, female
Head restraints	No/yes
Collision anticipated	No/yes
Seat in car during collision	5 possible seats
Site of collision	8 sectors
Seatbelt use	No/yes
Neck pain intensity	1 (no pain)–10 (severe pain)
Headache intensity	1 (no pain)–10 (severe pain)
Neck stiffness	1 (no stiffness)–10 (severe stiffness)
Severity of restriction of neck movements	1 (no restrictions)–10 (severe restrictions)
Radiating pain in arms	1 (no)–10 (severe pain)
Severity of paresthesia in the arms	1 (no)–10 (severe paresthesia)
Concentration symptoms	1 (no)–10 (severe symptoms)
Difficulty reading	1 (no)–10 (severe symptoms)
Difficulty attending to a conversation	1 (no)–10 (severe symptoms)
Dizziness	1 (no)–10 (severe dizziness)
Use of medication since collision	No/yes
Sleep disturbance	No/yes
Daily duration of pain	1 (always) to 5 (less than 3 hours)
Onset of neck symptoms	Hours after collision
Tampa scale of kinesiophobia	17–68

RESULTS

Participants and Response

During the intake period we sent 889 questionnaires. The median time of dispatch was 19 days after the collision (P_{25} = 13 days, P_{75} = 28 days). The number of questionnaires returned was 590 (66%). Among those returned, the median time for return was 32 days after the collision (P_{10} = 18 days, P_{90} = 65 days). Forty-seven percent of questionnaires were returned within 30 days, 67% within 40 days. Most collisions took place on Fridays (19%); 12% and 10% of the collisions took place on Saturdays and Sundays.

We studied the total duration of symptoms in a group of 367 eligible subjects. Table 2 summarizes the reasons for exclusion of 223 of the 590 questionnaires received. Compared with the group with insufficient information (n = 88), the eligible group (n = 367) was on average 3 years younger (*t* test, $P = 0.044$), had a similar male/female composition (chi-square test, $P = 0.78$), and had a similar time-to-claim closure distribution (Cox regression, $P = 0.74$). Table 3 presents the basic characteristics of the eligible group. During the follow-up, 51% of this group became free of neck symptoms. Figure 1 shows the Kaplan-Meier curve. The estimated percentage of subjects with neck symptoms persisting 1 year after the collision was 47% (SE 2.7%). The median of the duration of symptoms was 180 days.

In the eligible group (n = 367), Q1 was returned after a median delay of 32 days after the collision (P_{10} = 18 days, P_{90} = 67 days). Of the eligible group, 211 subjects could be included for further analyses of duration of neck symptoms after filling out Q1. From the respondents we excluded 86 subjects who were already symptom-free, 44 subjects who were symptom-free at the time of filling out Q1 according to the Q2 but not according to Q1 (thus providing inconsistent information), and 26 subjects who did not return Q2. Table 3 summarizes the basic characteristics of the study group, and Table 4 presents the symptom-related information.

Duration of Neck Symptoms

Table 5 summarizes the results of Cox regression analyses. Three models are presented. All of them include sex, age, delay, and a variable indicating whether the collision occurred during the first 3 months of the study.

TABLE 2. Overview of Included and Excluded Subjects

Questionnaires sent		889	100%
Returned		590	66%
Excluded			
Too young/too old	20		
No collision/no neck symptoms	101		
Insufficient data	88		
Already suffered chronic pain or whiplash	11		
Various	3		
Total excluded	223		
Eligible		367	

These potential "basic" confounders appeared to be related to the outcome at some stage of the analyses, although not all of them are significant in the final models. Model 1 results from including all variables except the questions concerning the nature of the symptoms. In addition to the basic variables, the model includes the TSK-DV score and the presence of head restraints. According to this model, a score 10 points higher on the TSK-DV corresponds to reducing by about a factor of 20 2 the instantaneous probability of becoming symptom-free. Surprisingly, the presence of head restraints was found to be associated with a longer duration of neck symptoms. The Kaplan-Meier curves in Figure 2 illustrate the effect of the TSK-DV.

Model 2 results from considering all variables except the TSK-DV score. We found three variables describing symptoms to be related to the outcome: neck stiffness, radiating pain in arms, and difficulty falling asleep were associated with a longer duration of neck symptoms. Model 3 results from considering all variables together. The results were similar to those in models 1 and 2; however, the effect of the TSK-DV score was smaller and no longer significant.

The models presented include three questions describing symptoms from Q1. Because the symptom-related questions were correlated, on interchanging some of these variables with other symptom-related questions, we obtained similar results The overall picture is that when we entered symptom-related information into the model, the effect of the TSK-DV score did not reach statistical significance.

In the linear regression analysis, the TSK-DV score was found to decrease with age ($P = 0.054$), to be higher for males ($P = 0.032$), and to increase with neck pain, concentration problems, and sleep disturbance (all $P < 0.001$); the adjusted r-square was 0.38. Cronbach's alpha for the TSK score was 0.76 (n = 211), similar to the value reported for other populations.[26]

DISCUSSION

Our study showed that a relation exists between the score on the TSK-DV and the duration of neck symptoms. However, when subjective symptom variables were added to the model, the TSK-DV score was no longer significantly related to the duration of neck symptoms. This loss of significance is due to correlation between specific symptoms and the TSK-DV score. The relation found between the duration of neck symptoms and sex and age has also been reported in other studies.[30,31]

In accordance with earlier research on kinesiophobia in low back pain, which showed a modest but significant relation between pain intensity and the TSK-DV score, we found the TSK-DV scores to be significantly related to the intensity of neck pain.[20,26] This is consistent with the understanding that a relation exists between anxiety and pain.[19] Furthermore, we found that men scored significantly higher on the TSK-DV, which

TABLE 3. Basic Characteristics of the Eligible Group (n = 367 unless stated otherwise) and of the Study Group With Symptoms on the First Questionnaire (n = 211)

	Eligible Group	Study Group With Symptoms on the First Questionnaire
Age		
Mean (SD)	36 (12)	38 (12)
Gender		
Male (%)	156 (42%)	88 (42%)
Car seat		
Driver	285 (78%) (n = 365)	160 (76%)
Where was the car hit		
Rear center	269 (81%) (n = 332)	156 (74%)
Use of seatbelts		
Yes	340 (93%)	196 (93%)
Head restraints		
Yes	354 (97%)	200 (95%)
Collision anticipated		
Yes	112 (31%) (n = 365)	68 (32%)
Day of the week		
Sunday to Saturday	10, 11, 15, 16, 17, 19, 12 (%)	10, 11, 11, 18, 20, 21, 10 (%)
Delay (collision to Q1, days)		
Median (P25, P75)		31 (22, 43)

is also reported in other studies.[26] Studies on post-whiplash syndrome, on the other hand, found that whiplash-injury related neck symptoms last longer in women.[20,30,32,33] We also found concentration problems and difficulty in falling asleep to be significantly related to the TSK-DV score. This suggests that an interaction exists between kinesiophobia, or pain-related fear, and the frequently reported cognitive symptoms.[19]

Our results do not seem to be consistent with the study by Nederhand et al.[25] There are several items that should be considered when comparing the results. First, there is a major difference in the targeted population. In the study by Nederhand et al, the participating patients were recruited after visiting a hospital emergency room. From as yet unpublished data in a study using a different

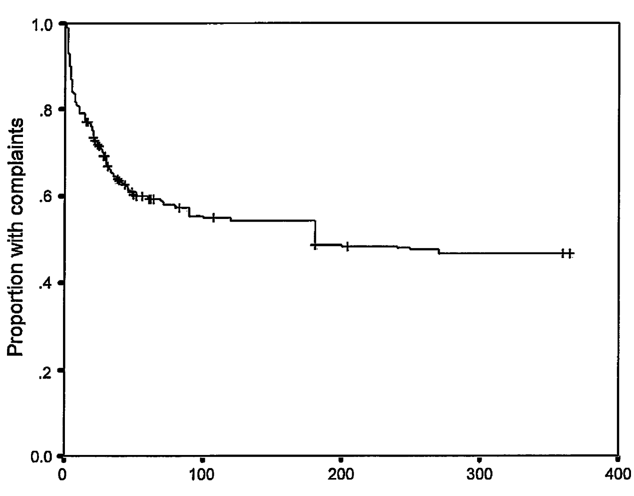

FIGURE 1. Kaplan-Meier curve of duration of neck symptoms in eligible group (n = 367). Vertical strokes mark censored observations.

sample from the same population, we estimate that only 50% of our targeted population visited a hospital after the collision. Recruiting from patients who visited a hospital after the collision could select a group exhibiting more symptoms and more fear.

Second, the primary outcome variable used is very different. Nederhand et al[25] used the score on the Neck Disability Index (NDI) after 6 months as the primary outcome variable. In our study the duration of neck symptoms was the primary outcome variable.

When the results of the study by Nederhand et al[25] are considered carefully, the differences are perhaps smaller than they first appear. We could not reject the null hypothesis of no effect of TSK adjusted for confounders. However, as Nederhand et al based their conclusions on an unadjusted analysis, adjustment of the results could remove the TSK effect in their data as well.

Because the TSK-DV score, when corrected for early subjective symptom reports, does not significantly relate to the duration of neck symptoms, it does not seem suitable as an instrument for predicting the duration of neck symptoms after motor vehicle collisions. However, the fact that the TSK-DV score is significantly related to the duration of neck symptoms when the early subjective symptom information is not considered leaves room for further discussion. Studies on chronic pain have shown that pain-related fear can lead to overprediction of pain, pain vigilance, and concomitant muscular activity, and therefore to possible higher scores on pain-related questions.[8,19,34–36]

We cannot explain the negative effects of head restraints on the duration of neck symptoms, as shown in model 1. Although some studies describe no significant relation between head restraints and the outcome of whiplash, the obvious surmise is that head restraints help to prevent acute neck distortion.[37,38] We feel that the negative relation found is an indication of the very limited

TABLE 4. Symptom-Related Characteristics at First Questionnaire (n = 211)

Intensity of neck pain (n = 210)	
Mean (sd)	6.0 (2.1)
Daily duration of pain (n = 208)	
Mean (sd)	2.3 (1.4)
Hours after collision until onset of neck symptoms, hours (n = 209)	
Median (P25, P75)	0 (0, 3)
Headache intensity (n = 211)	
Mean (sd)	5.0 (2.7)
Neck stiffness (n = 211)	
Mean (sd)	6.2 (2.6)
Severity of restriction of neck movements (n = 211)	
Mean (sd)	5.0 (2.3)
Extent of neck pain (n = 209)	
Mean (sd)	3.5 (2.8)
Severity of paresthesia in the arms (n = 210)	
Mean (sd)	3.0 (2.7)
Use of medication since collision (n = 211)	
Yes	120 (60%)
Concentration symptoms (n = 211)	
Mean (sd)	4.5 (2.9)
Difficulty reading (n = 211)	
Mean (sd)	4.0 (2.8)
Dizziness (n = 210)	
Mean (sd)	3.8 (2.9)
Sleep disturbance (n = 211)	
Yes	116 (55%)
Tampa Scale on kinesiophobia score (n = 211)	
Mean (sd)	40.5 (8.6)
Median (P25, P75)	41 (34, 47)

value of mechanical factors on the development of post-whiplash syndrome.[39]

This is one of the first studies using the TSK for patients with neck pain. Also, our study focused on the duration of neck symptoms, and not disability or other more behavioral parameters. Other studies on the value of kinesiophobia in whiplash used the NDI and, although limited to a 6-month follow-up, found no relation between the NDI and the TSK.[24,25] To achieve an adequate response we did not include a specific neck pain disability questionnaire.[40] Although the validity of some of these questionnaires has recently been questioned, we believe that conclusions on the validity of the fear-avoidance model in neck pain after motor vehicle collisions should be considered carefully.[41]

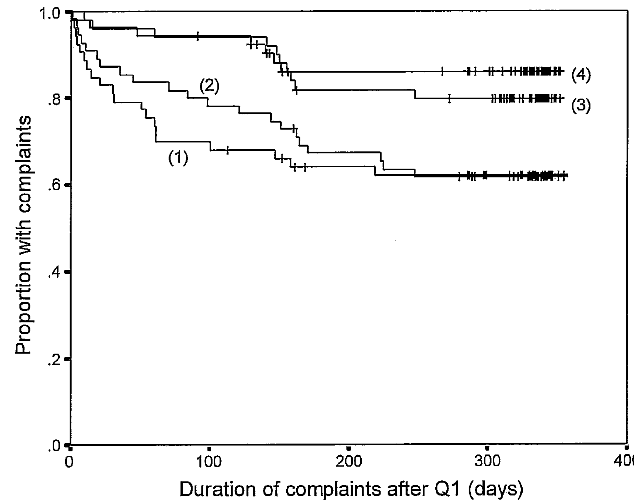

FIGURE 2. Kaplan-Meier curve of duration of symptoms in four groups (n = 211) defined by quartiles of the TSK-DV score. The positions of the curves correspond to the quartiles, the lowest curve being that for subjects with a TSK-DV below P25. Vertical slashes show censored observations.

A further limitation of our study is that because it involved a mailed survey, there was no control of the conditions under which the questionnaires were completed. Though the study group consisted of subjects who had initiated compensation claim procedures, we do not think that this induced a bias toward more serious symptoms.[15,42] In The Netherlands, starting such a procedure has a very low threshold. The damage report form used for claiming the car damage, and usually filled out within a few days of the collision, contains a section for the names of victims and their symptoms. We invited all claimants directly from these forms, including victims who did not seek medical help at the time or did not visit an emergency room at all. Furthermore, although the insurer and victim can be seen as opposing parties, most claims in The Netherlands, even large ones where serious injuries are involved, are settled out of court. None of the participating subjects were in actual litigation.

Although a recent study using a Functional Capacity Evaluation (FCE) as primary outcome found

TABLE 5. Results of Cox Regression

	Model 1			Model 2			Model 3		
Variable	**HR**	***P*-value**	**95%-CI**	**HR**	***P*-value**	**95%-CI**	**HR**	***P*-value**	**95%-CI**
Gender (M:F)	1.77	0.034	1.04–3.02	1.37	0.25	0.80–2.33	1.48	0.151	0.86–2.55
Age (10 years)	0.78	0.025	0.63–0.97	0.87	0.20	0.69–1.08	0.86	0.180	0.68–1.07
Study period	0.28	0.038	0.09–0.93	0.31	0.054	0.09–1.02	0.30	0.046	0.09–0.98
Delay (days)	0.98	0.025	0.96–1.00	0.98	0.029	0.96–1.00	0.98	0.030	0.86–1.00
Head restraints (N:Y)	3.06	0.021	1.18–7.9						
TSK-DV (10 points)	0.47	0.001	0.33–0.65				0.73	0.089	0.50–1.05
Restricted movements				0.83	0.007	0.73–0.95	0.85	0.020	0.74–0.98
Radiating pain in arms				0.80	0.003	0.69–0.93	0.82	0.010	0.71–0.95
Sleep disturbance				2.27	0.007	1.25–4.1	2.06	0.019	1.12–3.76

HR, Hazard Ratio; CI, Confidence Interval; Study period: first 3 months of the study compared to the rest.

no relation between kinesiophobia and the results on the FCE, future research on the role of kinesiophobia in neck pain after motor vehicle collisions should use a disability outcome.[43] Because the TSK was constructed for back pain, it should perhaps be adjusted when used for neck pain. Future research should examine which fears are specific to patients with traumatic neck pain. Furthermore, research on pain catastrophizing and its relation with neck pain after motor vehicle collisions should be conducted.

In summary, a higher TSK score was found to be associated with a longer duration of neck symptoms, but this relationship ceased to be significant after correction for early subjective symptoms. With knowledge of early symptoms at hand, the information on early kinesiophobia does not improve our ability to predict the duration of neck symptoms after motor vehicle collisions.

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